FNAL Engineering Note

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Project: MicroBoone/LAr

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Subject: High Voltage Leakage Test of RG180 and RG316 Cable

RG180 cable characteristics (Jaguar Industries data sheet)

MIL-C-17 Designation: M17/95-RG180
Jaguar Catalog #: JM17-95
Conductor Type: SCCS 7x.004
Core O.D.: PTFE .102
Shield: 1 SPC
Jacket: FEP .141
Nominal Impedance: 95 Ohm
Temperature Range: -55C +200C
Capacitance per foot: 17.4 pF
Maximum Working Voltage: 1,100
Weight: 1.98 pounds per 100 feet

Calculated voltage rating for the PTFE insulation of RG180 cable

The manufacturer's voltage rating does not indicate if the maximum working voltage given is a RMS value or DC value or at what frequency for a RMS value, other manufacturers typically use RMS. From the information given on the center conductor and insulation the minimum thickness of the PTFE core would be 0.045". This was determined by using [insulation diameter - (3 x strand diameter)] / 2. The dielectric strength or puncture voltage of PTFE is rated at 1kV to 2kV per 0.001 inch. If we use the lower number of 1kV then the calculated breakdown voltage for the RG180 cable is 45kV.

High Voltage Leakage Test of RG 180 Cable

24 Feet new RG180 used for testing.
Vern Kiebler model 6900 Positive HV power supply used for test, serial # 1051.
An 18” piece of HV RG58 with SHV was used to connect HV power supply to cable under test.
HP 974A DMM was used for all measurements of signals from Kiebler 6900 power supply.
The current reading was taken after one minute of sitting at voltage, the power supply’s internal metering was used for the current reading.

Voltage	Current	Current with RG180 disconnected	
zero	103 nA	110 nA	
1 kV	105 nA	110 nA	
2 kV	108 nA	112 nA	
3 kV	111 nA	115 nA	
4 kV	116 nA	119 nA	
5 kV	119 nA	123 nA	
6 kV	123 nA	126 nA	
7 kV	128 nA	131 nA	
8 kV	133 nA	136 nA	
9 kV	corona	corona	The corona occurred at the open end of the RG58
zero		112 nA	cable where it would connect to the cable under test.

RG316 cable characteristics (Jaguar Industries data sheet)

MIL-C-17 Designation: M17/113-RG316
Jaguar Catalog #: JM17-113
Conductor Type: SCCS 7x.0067
Core O.D.: PTFE .060
Shield: 1 SPC
Jacket: FEP .098
Nominal Impedance: 50 Ohm
Temperature Range: -55C +200C
Capacitance per foot: 32 pF
Maximum Working Voltage: 900
Weight: 1.22 pounds per 100 feet

Calculated voltage rating for the PTFE insulation of RG316 cable

The calculated breakdown voltage using the above procedure is 20 kV.

High Voltage Leakage Test of RG316 Cable

75 Feet new RG316 used for testing.
Vern Kiebler model 6900 Positive HV power supply used for test, serial # 1051.
An 18" piece of HV RG58 with SHV was used to connect HV power supply to cable under test.
HP 974A DMM was used for all measurements of signals from Kiebler 6900 power supply.
The current reading was taken after one minute of sitting at voltage, the power supply's internal metering was used for the current reading.

Voltage	Current	Current with RG316 disconnected	
zero	107 nA	112 nA	
1 kV	110 nA	113 nA	
2 kV	112 nA	115 nA	
3 kV	116 nA	119 nA	
4 kV	120 nA	122 nA	
5 kV	123 nA	125 nA	
6 kV	127 nA	129 nA	
7 kV	131 nA	134 nA	
8 kV	137 nA	139 nA	
9 kV	corona	corona	The corona occurred at the open end of the RG58
zero		114 nA	cable where it would connect to the cable under test.

Conclusions

The measurements of both RG180 and RG316 cables would indicate that the leakage currents of each length of cable was less than 10 nanoAmps and that there was no HV breakdown in the cables at the tested voltages.